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that igneous activity began in late Cretaceous or very early Eocene time and continued till very recently, and that there were several quite distinct periods."

V. O. T.

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*Permian of "Permo-Carboniferous" of the Eastern Foothills of the Rocky Mountains in Colorado.* By R. M. BUTTERS. Bull. Colo. Geol. Surv. No. 5, Part 2, pp. 65-101. Fig. 1.

This report is concerned with the determination of the age of the Lykins formation, which was assigned by Fenneman to the upper part of the "Red Beds" in the Front Range of eastern Colorado.

The Lykins formation, which varies considerably in thickness, consists of red shales and shaly sandstones, with a few sandy or shaly limestone beds. On the basis of the faunal evidence, the lower part of the Lykins is placed in the Pennsylvanian and an intermediate zone above is tentatively correlated with the Rico formation (Permian(?)) of the San Juan region. "This leaves 100-400 feet of shales to represent the Permian or the remainder of the Permian, the Triassic, and all the Jurassic up to the Morrison."

V. O. T.

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*The Geology of Central Ross-shire.* By B. N. PEACH, L. W. HINXMAN, E. M. ANDERSON, J. HORNE, C. B. CRAMPTON, R. G. CARRUTHERS. Petrological Notes by J. S. FLETT. Memoirs of the Geological Survey of Scotland, No. 82, 1913. Pp. 114, pls. 8, figs. 10.

The western quarter of County Ross is cut off by the great Moine thrust line. The Strathconan fault is the dominant one in the area considered. It is of the type described as a "wrench fault." The direction of the fault line is a little east of north, and the lateral movement was to the northeast on the east side, and to the southwest on the western side. There are many Lewisian inliers thrust upon the younger Moine series.

The Lewisian gneiss is a basement complex of various rocks of different ages and includes altered sedimentary rocks that were denuded and affected by contact metamorphism before the deposition of the Moine sediments.

The Moine series comprises quartzose schists or quartz-biotite granulites and garnetiferous mica-schists or pilitic gneiss, representing

respectively metamorphosed silicious and argillaceous sediments. Locally the base of the series is conglomeratic. They are divided into an upper and a lower silicious zone.

Torridonian strata occupy most of the unmoved area east of the fault line. The beds are chiefly coarse, chocolate and red arkoses and pebbly grits which carry occasional layers of shale and flagstone.

Unconformable upon the Torridon beds lie the Cambrian. The Cambrian is based with a gritty quartzite; the upper Fucoid limestones carry an *Olenellus* fauna.

An apparent metamorphic transition of Torridon into Moine schists is reported, but no suggestion is made as to the age of the Moine schists relative to the Cambrian and Torridonian.

The petrology of the district is marked by unusual lamprophyre dikes of minette and monchiquite relationships.

The last twenty pages are given to a discussion of Pleistocene glaciation and glacial deposits.

T. T. Q.

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*The Archean Geology of Rainy Lake Re-studied.* By ANDREW C. LAWSON. Geol. Surv. Canada, Memoir No. 40, 1913. Pp. 115, pls. 9, map 1.

Field study confirms the author's earlier opinion (of 1887) that the Couthiching sedimentary series is older than the Keewatin igneous rocks. He found that there were two widely separated periods of plutonic activity; to the earlier he proposes to confine the name Laurentian, and for the younger he introduces the term Algoman.

Lawson's classification of Archean formations from the top downward is as follows:

1. Eparchean interval—peneplanation.
2. Algoman. Vast batholiths of granite- and syenite-gneisses.
3. Seine series (Upper Huronian, Middle Huronian of some authors). Conglomerates, quartzites and slates.
4. Uplift, deformation and erosion, followed by depression.
5. Steep rock series (Lower Huronian). Sediments and volcanics. Several hundred feet of fossiliferous limestones.
6. Erosion which extensively exposed the granite batholiths.
7. Laurentian. Granites and granite-gneiss.
8. Keewatin. Chiefly volcanic rocks with intercalated sedimentary beds. Certain intrusive gabbros.
9. Couthiching. Sedimentary strata. Mica schist and paragneiss.